Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment, claims 1-47 are pending in the application, with claims 1, 20, and 29 being the independent claims. Claim 29 has been amended to correct a minor error in the preamble of the claim. This change is believed to introduce no new matter, and its entry is respectfully requested.

Based on the above amendment and the following remarks, Applicant respectfully requests that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Rejections under 35 U.S.C. § 103

The Examiner has rejected claims 1-10, 12, 13, 15-17, 18, 20-27, 29-38, 40-43, 45 and 47 under 35 U.S.C. § 103(a) as being unpatentable over Marcellin *et al.*, "A Trellis-Searched 16 KBit/Sec Speech Coder with Low Delay," ADVANCES IN SPEECH CODING, dated March 5, 1992 ("Marcellin") in view of Watts *et al.*, "A Vector ADPCM Analysis-By-Synthesis Configuration for 16 kbit/s Speech Coding," IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE & EXHIBITION: "COMMUNICATIONS FOR THE INFORMATION AGE," 1988 ("Watts"). Based on the following remarks, Applicant respectfully traverses.

Independent claims 1 and 29 each generally relate to a novel way of performing vector quantization in a Noise Feedback Coding (NFC) system. In particular, independent claim 1 is directed to a method in an NFC system of efficiently searching N

predetermined Vector Quantization (VQ) codevectors for a preferred one of the N VQ codevectors to be used in coding a speech or audio signal. The method of claim 1 includes the steps of:

> (a) predicting the speech signal to derive a residual signal;
>
> (b) deriving a ZERO-INPUT response error vector common to each of the N VQ codevectors;
>
> (c) deriving N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors; and
>
> (d) selecting the preferred one of the N VQ codevectors as the VQ output vector corresponding to the residual signal based on the ZERO-INPUT response error vector and the N ZERO-STATE response error vectors.

Independent claim 29, as presently amended, is directed to an NFC system for fast searching N VQ codevectors stored in a VQ codebook for a preferred one of the N VQ codevectors to be used for coding a speech or audio signal. The NFC system of claim 29 includes:

> predicting logic adapted to predict the speech signal to derive a residual signal;
>
> a ZERO-INPUT filter structure adapted to derive a ZERO-INPUT response error vector common to each of the N VQ codevectors in the VQ codebook;
>
> a ZERO-STATE filter structure adapted to derive N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors in the VQ codebook; and
>
> a selector adapted to select the preferred one of the N VQ codevectors as a VQ output vector corresponding to the residual signal based on the ZERO-INPUT response error vector and the N ZERO-STATE response error vectors.

The combination of Marcellin and Watts does not teach or suggest each of the features of claims 1 or 29. For example, neither Marcellin nor Watts teaches deriving "a

ZERO-INPUT response error vector common to each of the N VQ codevectors" or deriving "N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors" as recited in claims 1 and 29.

Marcellin is directed to a Noise Feedback Coding structure that uses Trellis Coded Quantization (TCQ) rather than vector quantization. Consequently, Marcellin does not describe performing operations involving groups of samples known as "vectors." In fact, Marcellin itself teaches that TCQ is something entirely different from vector quantization:

> The mean squared error (MSE) performance of TCQ is excellent. For encoding the memoryless uniform source, TCQ achieves a MSE within 0.21 dB of the distortion-rate function at all positive integral rates. This performance is better than that promised by the best lattices known in up to 24 dimensions [8]. In fact, evaluation of the asymptotic quantizer bound [9] indicates that ***no vector quantizer of dimension less than 69 can exceed the performance of TCQ*** for encoding the memoryless uniform source.

See Marcellin at p. 47, second paragraph (emphasis added). Since Marcellin does not teach or suggest performing operations involving vectors, it does not teach or suggest deriving "a ZERO-INPUT response error vector common to each of the N VQ codevectors" or deriving "N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors" as recited in claims 1 and 29.[1]

Watts is directed to a speech coder having an ADPCM configuration that utilizes a vector quantizer. Although Watts does describe calculating a "zero input response" and

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[1] The Examiner has asserted that "deriving a response error vector common to each of the N VQ codevectors" is taught at page 48, paragraph 3 through page 49, paragraph 2 of Marcellin. *See* Office Action at p. 5. Contrary to the Examiner's assertion, this text simply discusses properties of various elements of Marcellin's prior art NFC structure and appears to have nothing to do with deriving a vector of any kind. The Examiner has also indicated that "deriving N response error vectors each based on a corresponding one of the N VQ codevectors" is taught at page 50, paragraphs 1-2 of Marcellin. *See* Office Action at p. 5. Contrary to this assertion, the cited text simply discusses performing TCQ on a data sequence and appears to have nothing to do with deriving vectors of any kind.

"zero state response" of a filter to select a codevector for the purposes of performing vector quantization, it does not teach deriving "a ZERO-INPUT response ***error vector*** common to each of the N VQ codevectors" or deriving "N ZERO-STATE response ***error vectors*** each based on a corresponding one of the N VQ codevectors" as recited in claims 1 and 29.

As explained in the specification of the present application, an embodiment of the present invention decomposes a quantization error vector into a zero-input response error vector and zero-state response error vector:

> A computationally more efficient codebook search method according to the present invention is based on the observation that the feedback structure in FIG. 13C, for example, can be regarded as a linear system with the VQ codevector out of scaled VQ codebook 5028a as its input signal, and ***the quantization error q(n) as its output signal. The output vector of such a linear system can be decomposed into two components: a ZERO-INPUT response vector qzi(n) and a ZERO-STATE response vector zqs (n)***. The ZERO-INPUT response vector qzi(n) is the output vector of the linear system when its input vector is set to zero. The ZERO-STATE response vector qzs(n) is the output vector of the linear system when its internal states (filter memories) are set to zero (but the input vector is not set to zero).

See Specification at paragraph [0227]. Watts does not anywhere teach or suggest decomposing a vector representing quantization error (or any type of error for that matter) to derive a zero-input response error vector and zero-state response error vectors as claimed. Rather, Watts teaches decomposing vectors representing predicted speech (denoted $\hat{x}_n$) and reconstructed speech (denoted y_n) into zero-input response and zero-state response components as illustrated by Watt's equations (6)-(9). This difference

between Watts and the invention of claims 1 and 29 is due in part to the structure of Watt's speech coder, which is depicted in Figure 1(b) of Watts.[2]

Since neither Marcellin nor Watts, alone or in combination, teach or suggest each and every feature of independent claims 1 or 29, the combination of Marcellin and Watts fail to support a prima facie obviousness rejection of those claims. Accordingly, the Examiner's rejections of claims 1 and 29 under 35 U.S.C. § 103(a) are traversed and Applicant respectfully request that the rejections be reconsidered and withdrawn. Dependent claims 2-10, 12-13, 15-17, 18, 29-38, 40-43, 45 and 47 are also not rendered obvious by this combination for at least the same reasons as independent claims 1 and 29 from which they depend and further in view of their own respective features. Accordingly, the Examiner's rejections of claims 2-10, 12-13, 15-17, 18, 29-38, 40-43, 45 and 47 under 35 U.S.C. § 103(a) are likewise traversed and Applicant respectfully request that these rejections be reconsidered and withdrawn.

Independent claim 20 is directed to a novel method of deriving a final set of codevectors for use in vector quantization. In particular, claim 20 recites a method of deriving a final set of N codevectors useable for prediction residual quantization of a

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[2] It should be noted that the speech coder in Watts is not a "noise feedback coder" as that term is used in the present application. This is because the speech coder in Watts does not generate a difference signal between a quantizer input and output, pass this value through a filter, and then add the filtered output to a prediction residual to form the quantizer input signal. As set forth in the specification of the present application:

> In noise feedback coding, the difference signal between the quantizer input and output is passed through a filter, whose output is then added to the prediction residual to form the quantizer input signal. By carefully choosing the filter in the noise feedback path (called the *noise feedback filter*), the spectrum of the overall coding noise can be shaped to make the coding noise less audible to human ears.

See Specification at paragraph [0007]. The speech coder in Watts is shown as including a "noise feedback filter" (*see* Watts, Figure 1(b)); in actuality, however, this filter is a feed-forward filter and the "noise" referred to is not quantization noise.

speech or audio signal in a Noise Feedback Coding (NFC) system. The method of claim 20 includes the steps of:

> (a) deriving a sequence of residual signals corresponding to a sequence of input speech training signals;
>
> (b) quantizing each of the residual signals into a corresponding preferred codevector selected from an initial set of N codevectors to minimize a quantization error associated with the preferred codevector, thereby producing a sequence of preferred codevectors corresponding to the sequence of residual signals;
>
> (c) deriving a total quantization error energy for one of the N codevectors based on the quantization error associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors; and
>
> (d) updating the one of the N codevectors to minimize the total quantization error energy.

In the Office Action, the Examiner asserts that all the foregoing method steps are taught by Marcellin. Consequently, it is unclear whether the Examiner intended to reject claim 20 under 35 U.S.C. § 102 as anticipated by Marcellin rather than under 35 U.S.C. § 103 as obvious over Marcellin in view of Watts. In any case, Applicant submits that claim 20 is patentable over Marcellin either alone or in combination with Watts, and thus respectfully traverses.

As discussed above, Marcellin teaches an NFC structure that uses Trellis Coded Quantization (TCQ) rather than vector quantization. Consequently, Marcellin does not anywhere describe performing operations involving groups of samples known as "vectors." Thus, Marcellin does not teach or suggest "a novel method of deriving a final set of N codevectors useable for prediction residual quantization of a speech or audio signal in a Noise Feedback Coding (NFC) system" as recited in claim 20. Since the

structure in Marcellin uses TCQ rather than vector quantization, there is simply no need to derive a final set of codevectors usable for vector quantization in Marcellin.

Although Watts teaches a speech coder that utilizes vector quantization, it does not teach or suggest the particular method of deriving a final set of codevectors set forth in claim 20. For example, Watts does not teach or suggest the step of "deriving a total quantization error energy for one of the N codevectors based on the ***quantization error*** associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors" as recited in claim 20, since Watts nowhere teaches or suggests deriving a quantization error. Rather, the only error dealt with in Watts is termed a "reconstruction error", which is defined as the difference between the original speech signal (denoted x_n) and the reconstructed speech signal (denoted y_n). *See* Watts, p. 276.

Since neither Marcellin nor Watts, alone or in combination, teach or suggest each and every feature of independent claim 20, the combination of Marcellin and Watts fail to support a prima facie obviousness rejection of this claim. Accordingly, the Examiner's rejection of claim 20 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully request that the rejections be reconsidered and withdrawn. Dependent claims 21-27 are also not rendered obvious by this combination for at least the same reasons as independent claim 20 from which they depend and further in view of their own respective features. Accordingly, the Examiner's rejections of claims 21-27 under 35 U.S.C. § 103(a) are likewise traversed and Applicant respectfully request that these rejections be reconsidered and withdrawn.

Claim Objections

The Examiner has objected to claims 11, 14, 17, 19, 28, 39, 44 and 46 as being dependent upon rejected base claims. For the reasons set forth above, the rejections of the base claims have been traversed. Accordingly, Applicant respectfully request that the objection to claims 11, 14, 17, 19, 39, 44 and 46 be reconsidered and withdrawn.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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